One of the most critical functions of the skin is to provide a barrier from the outside world: to keep water in and keep allergens, irritants, and infectious agents out. When the skin barrier is not performing optimally—due to a genetic disease, the presence of inflammation, or physical disruptors such as scratching—the vicious cycle of eczema may ensue. When this occurs, moisturizers can act in a number of ways to stand in for the normal skin barrier function, ideally while also helping to restore the skin to its natural state.

Moisturizers are thus used in the treatment of numerous skin conditions, such as eczema, psoriasis, and irritant dermatitis, protecting and rehydrating the skin where needed. Commercially available preparations cover the range of excipients: from water-dominant lotions to greasy ointments, and many intermediate preparations. Consumers spend billions of dollars each year on these products in hopes of a simple solution for dry and irritated skin. Despite all the popularity and a dizzying array of options, no accepted treatment guidelines exist for the use of moisturizers in dermatology, forcing consumers and clinicians to rely on advertising, a patchwork of research, and personal experience to make sense of all the formulations.

**Moisturizers and dermatologic conditions**

Eczema (atopic dermatitis) is perhaps the “poster child” for moisturizers and there is reasonably good evidence that using moisturizers more frequently directly relates to improvement in eczema severity. The structural protein filaggrin helps maintain the integrity of the epidermal barrier, an important line of defense. Loss of function mutations that prevent expression of filaggrin play an important role in the development of both atopic disease and ichthyosis vulgaris. Indeed, filaggrin deficiency leads to a defective skin barrier that allows increased water loss and increased allergen exposure through the skin, which may lead to inflammatory reactions. However, even in patients with normal filaggrin genes, the presence of inflammation in the skin (specifically IL-4 and IL-13) causes significantly reduced filaggrin gene expression, resulting in functional filaggrin deficiency. In other words, irritated skin from many causes can make for an impaired skin barrier, making moisturizers just as important in restoring epidermal barrier function in these patients.

Psoriasis, though thought to consist of a predominantly Th1-type of inflammatory response (versus the Th2-type seen in atopic dermatitis), has long been known to respond favorably to moisturizer use. The role of moisturizers in psoriasis treatment seems to be to help normalize skin growth and differentiation as well as elicit anti-inflammatory effects, which may be similar to those in eczema.

**Moisturizer classification**

Moisturizers can be subdivided into several components based on their ingredients and mechanisms of action. The main functions of moisturizers are reducing transepidermal water loss (TEWL), attracting water to the stratum corneum, and repairing the overall barrier function. Some of the important components include:
Oclusives, which physically block TEWL in the stratum corneum and enhance the penetration of ingredients. Most effective oclusives are (in order of effectiveness): petrolatum, lanolin, mineral oil, and silicones. They are generally very greasy, which can lead to poor adherence in some patients. When overused, they may cause folliculitis.

Emollients are oil-in-water or water-in-oil preparations and include fatty acids, cholesterol, and ceramides. Emollients play a role in the water retention capability of the stratum corneum and function to make the skin smooth and supple.

Humectants are hygroscopic (water-attracting) substances that actively pull water and hydrate the stratum corneum. Examples of humectants include glycerin, alpha hydroxy acids, and other sugars. Their function is to restore the skin’s ability to attract, hold, and redistribute water.

Moisturizers are made in a variety of formulations, which continue to become more complex with new technological advancements. Popular water-based products include gels, lotions, suspensions, and aqueous creams. Water-based preparations are generally more cosmetically elegant and preferred by consumers, as they do not leave a sticky residue. However, they may lack some occlusive properties as compared to the ointment-based vehicles, and can actually end up adding very little water to the skin in some cases.

Ointment-based preparations are predominantly greases or oils, with little or no water. These tend to have excellent occlusive properties and generally do not sting or burn. However, they may not be able to add hygroscopic molecules to the skin or barrier components and may be perceived as unpleasantly greasy.

Emulsions span a wide range of formulations, from water-based lotions and gels to greasy ointments. These can be predominantly oil-based with some water (water-in-oil) or a predominant water base with some oil (oil-in-water). Many of the most commonly recommended products fall into this category, and there is potential to have all of the important components of moisturization represented in a good emulsion.

There have been several attempts to better quantify the consistency or “feel” of moisturizers, with a recent study describing a measurement called the “hydrophilic index.” This index is based on a physical assay that measures the amount of water retained by a sample of moisturizer or excipient, in order to approximate the “greasiness” of a particular formulation.

Beyond these, moisturizers can be categorized based on their pH. Topical products that fall within the physiological skin pH range of 4 to 6 may stabilize or improve the protective acid mantle of the skin. They may also prevent and treat skin conditions that disrupt the skin barrier and its antimicrobial functions. Ideally, those moisturizers with a pH near the ideal range (or perhaps even a bit more acidic) would be selected. However, there is more research to be done on this topic, as it is likely more complex than the measured pH alone.

**NOVEL MOISTURIZER TECHNOLOGIES**

Some of the newest formulations contain ceramides or waxy lipid molecules composed of sphingosine and fatty acids. Ceramides restore skin water permeability barrier function, and are effective occlusives are (in order of effectiveness): petrolatum, lanolin, mineral oil, and silicones. They are generally associated with low OA and high LA ratios. High LA concentrations have been shown to accelerate skin barrier development and repair, hydrate the skin, and, as a result, reduce the severity of atopic dermatitis and be steroid sparing. Some natural oils with the highest LA/OA ratios are safflower oil, sunflower seed oil, and sea buckthorn seed oil. In contrast, olive oil, with its relatively low LA/OA ratio, can
Preservatives

Preservatives are commonly added to moisturizers to inhibit the growth of bacteria, yeast, fungi, or algae. They stabilize the products and give them a cosmetically elegant feel, as well as extend the shelf life. Some of the most common preservatives in cosmetics include parabens, formals, and benzyl alcohol. Recent controversy with the use of parabens stems from a 2004 study that found increased levels of parabens in the tissue of patients with breast cancer. Even though parabens have estrogenic properties, it should also be noted that the European Cosmetic Toiletry and Perfumery Association (COLIPA) found that parabens are hydrolyzed in the skin and that they do not enter the bloodstream.

The estrogenic properties of parabens, depending on the compound, are up to one million times less than estradiol, and they also possess aromatase-inhibiting properties, thereby reducing the conversion of testosterone to estrogen. Parabens are not officially identified or listed as an endocrine disrupting chemical by any governmental or regulatory agency, but public pressure has influenced some countries to introduce regulations on the use of parabens in consumer products. Furthermore, parabens are added to cosmetics in very small amounts that do not exceed 1% of total weight, making the possibility of systemic absorption miniscule. Additionally, the study author herself (Dr. Darbre) stated in reply to concerns raised about the paper: “Nowhere in the manuscript was any claim made that the presence of parabens had caused the breast cancer, indeed the measurement of a compound in a tissue cannot provide evidence of causality.” Despite these points, there has been a growing consumer push to avoid parabens in all forms, and a compensatory upswing in products touting “parabens free” from many manufacturers.

Moisturizers, particularly modern ones, are highly complex and can affect the skin in multiple ways. However, they all strive to do similar things: keep water in the skin, keep allergens and irritants out of the skin, make the skin feel soft, and, when appropriate, help carry medicines or other treatments that can strengthen or treat the skin. In general, greasy ointments do the best job of occluding the skin: locking water in and keeping irritants and allergens out. These also tend to be ones that do not sting or burn when applied, and they tend to need fewer or no preservatives, all of which are favorable attributes. However, they are greasy and cosmetically inelegant, which means that some patients will not use them, or they will use them less frequently than recommended. Increasing water in a greasy preparation creates emulsions, which can be creams or lotions. These are less occlusive, may feel cooling when applied, and absorb more readily into the skin, increasing compliance for many patients. However, these can sting or irritate inflamed or open skin and often require preservatives, which can be allergens and may be undesirable to some patients.

I recently co-authored a study that examined some physicochemical properties of various moisturizers, including heavier and greasier agents, such as Aquaphor Ointment (Beiersdorf), as well as Eucerin Original Dry Skin Cream and Lotion (Beiersdorf). We also examined lighter agents such as Dove Day Lotion SPF 15 (Unilever), CeraVe Moisturizing Cream (Valeant Pharmaceuticals), and Neosalus Cream (Quinnova), as well as agents that fall somewhere in between, such as Cetaphil Restoraderm (Galderma) and Aveeno Advanced Care Moisturizing Cream (Johnson & Johnson). Our goal was to determine how much water each moisturizer “hung on to,” so to speak, and this way we could layer out the oil from the water layer to measure it. The index we created (hydrophilic index) can help guide patients to how “greasy” a preparation might feel, and perhaps to lead them to something more suitable given what has worked for them in the past. In general, however, there is no perfect moisturizer; just a range that may be helpful for certain patients, and even that can change depending on their skin at the time and the season.

We found that the greasier ointments were generally more hydrophobic, as one might expect. These tend to be great at “locking the skin down” and keeping water in, but often feel heavy and greasy. Those that held on to more water tended to be more hydrophilic, which could mean that they are less occlusive but perhaps are able to bring some water and lipids deeper into the skin, rather than just sit on top. Clinically, I find that a combination of both types often is the best recipe: a lighter cream during the day when the skin is dry to bring water and fats into the skin, and a heavy, occlusive ointment at night after a bath to lock the water in.

—Peter Lio, MD
CONCLUSION

Moisturizers continue to be an important adjunct therapy for a variety of dermatologic conditions, especially atopic dermatitis. As we learn more about skin barrier function and mechanisms leading to barrier dysfunction, new technologies lead the way in our search for the perfect moisturizer. With such a vast array of options, it can be challenging for an average consumer to choose the best option for their skin type, condition, and budget. This underscores the importance for dermatologists to keep abreast of new commercially available as well as prescription products, their efficacy, safety profile, and cost-effectiveness.

Lidia Shettle, PA-C is a board-certified Physician Assistant at Dermatology and Aesthetics of Wicker Park in Chicago. She is a member of the American Academy of Physician Assistants and the Society of Dermatology Physician Assistants.

Peter A. Lio, MD is a Clinical Assistant Professor in the Department of Dermatology & Pediatrics at Northwestern University, Feinberg School of Medicine.